

# PATENT ABSTRACTS OF JAPAN

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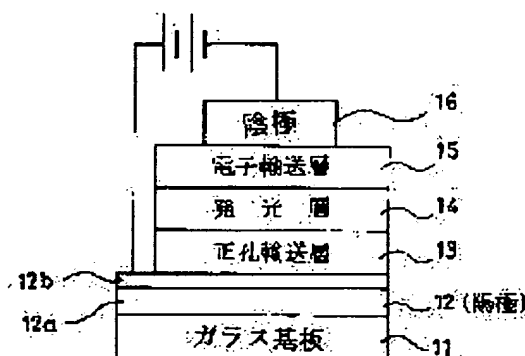
(72)Inventor : SANO HIROYUKI

## (54) ORGANIC LIGHT-EMITTING ELEMENT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an organic light-emitting element which solves the problems of short circuit and dark spots caused by local protrusions of transparent conductive films of an anode.

**SOLUTION:** This organic light-emitting element has the anode 12, having the two-layer constitution by respectively forming the polycrystalline transparent conductive film 12a on the surface of a glass substrate 11, and the amorphous transparent conductive film 12b on the film 12a.



## LEGAL STATUS

[Date of request for examination]

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**CLAIMS**

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[Claim(s)]

[Claim 1] The organic light emitting device characterized by to equip a transparence substrate side with the anode plate of the two-layer configuration which carried out film formation of the transparent conductive film amorphous on it for the transparent conductive film of polycrystal respectively in the organic light emitting device which consists of cathode which carried out membrane formation formation on the organic layer which the transparence substrate side was made to deposit the anode plate of the transparence which carried out membrane formation formation, and on this anode plate film, and this organic layer.

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[Translation done.]

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the organic light emitting device equipped with the luminous layer which consists of organic material.

[0002]

[Description of the Prior Art] Drawing 3 is the simple block diagram showing an example of an organic light emitting device. This organic light emitting device carries out film formation of the electron hole transportation layer 13, a luminous layer 14, and the electronic transportation layer 15 one by one on the transparent glass substrate 11 which carried out film formation of the anode plate 12, and has further structure which carried out film formation of the cathode 16 at the electronic transportation layer 15 so that it may illustrate. In addition, a glass substrate 11 has some which were formed by transparent plastics material.

[0003] The anode plate 12 is formed with the large metal and large alloy of a work function. Specifically, it is the transparent conductive film of the polycrystal formed using ITO (oxide of indium-tin), SnO<sub>2</sub> (tin oxide), ZnO (zinc oxide), etc.

[0004] Moreover, film formation of the electron hole transportation layer 13, a luminous layer 14, and the electronic transportation layer 15 is carried out by organic material (organic compound). The macromolecule system material specifically represented with the low-molecular system material represented by Alq<sub>3</sub> (aluminum chelate complex) and TPD (aromatic series diamine) or a PPV (polyphenylene vinylene) derivative is used.

[0005] The above-mentioned cathode 16 is formed with the mixture of a metal and an alloy with work-related [ small ], or a these metals and an alloy. Specifically, it is the cathode which carried out thin film formation of calcium (calcium), aluminum (aluminum), an aluminum-Li (lithium) alloy, a Mg (magnesium)-Ag (silver) alloy, a Mg-aluminum alloy, the Mg-In (indium) alloy, etc. by approaches, such as vacuum evaporation and sputtering.

[0006] When the above-mentioned organic light emitting device impresses direct current voltage to an anode plate 12 and cathode 16, the electron hole poured in from an anode plate 12 is sent to a luminous layer 14 through the electron hole transportation layer 13. Moreover, the electron poured in from cathode 16 is sent to a luminous layer 14 through the electronic transportation layer 15. In a luminous layer 14, an electron hole and an electron recombine, by this, the organic material of a luminous layer 14 will be in an excitation state, and an exciton generates.

[0007] Thus, the generated exciton diffuses the inside of a luminous layer 14, deexcitation is carried out continuously to that ground state, light is then emitted, and this luminescence is injected through the electron hole transportation layer 13, an anode plate 12, and a glass substrate 11.

[0008] Drawing 4 is the simple block diagram of the organic light emitting device constituted so that a luminous layer 14 might serve as the electronic transportation layer 15. As for this light emitting device, film formation of the anode plate 12 is carried out at a glass substrate 11, the laminating of the electron hole transportation layer 13 and the luminous layer 14 is carried out on it, and film formation of the

cathode 16 is carried out at the luminous layer 14.

[0009] Drawing 5 is a simple block diagram of an organic light emitting device with which a luminous layer 14 serves as the electron hole transportation layer 13. As for this light emitting device, film formation of the anode plate 12 is carried out at a glass substrate 11, the laminating of a luminous layer 14 and the electronic transportation layer 15 is carried out on it, and film formation of the cathode 16 is carried out at the electronic transportation layer 15.

[0010] Drawing 6 is the simple block diagram of the organic light emitting device which is not equipped with the electron hole transportation layer 13 and the electronic transportation layer 15. As for this light emitting device, film formation of the anode plate 12 is carried out at a glass substrate 11, the laminating of the luminous layer 14 is carried out on it, and film formation of the cathode 16 is carried out at the luminous layer 14.

[0011] The organic light emitting device shown in drawing 4, drawing 5, and drawing 6 emits light by impressing direct current voltage to an anode plate 12 and cathode 16 like the organic light emitting device shown in drawing 3, and this luminescence injects it through an anode plate 12 and a glass substrate 11.

[0012] The luminescent color of the above-mentioned conventional organic light emitting device has a large place depending on the organic material of a luminous layer 14. In current, the organic light emitting device of green, yellow, orange, red, and the blue luminescent color is put in practical use and proposed.

[0013]

[Problem(s) to be Solved by the Invention] As shown in drawing 7, on the field of a glass substrate 11, patterning of the transparent conductive film of polycrystal is carried out after membrane formation and to an electrode configuration according to vacuum membrane formation or wet process, and thin film formation of the anode plate 12 of the above-mentioned organic light emitting device is carried out.

[0014] Therefore, when carrying out membrane formation of the anode plate 12 using ITO of polycrystal, partial growth of crystal grain (grain) arises like a film formation fault, and local upheaval (many projecting parts of irregular arrangement) of a crystal arises on a film surface.

[0015] Since magnitude (height) becomes 1500Å or more, this local upheaval comes to break through the organic layer (an electron hole transportation layer or luminous layer) made to deposit on an anode plate 12. For this reason, the defect resulting from short-circuit or dark spot (non-light-emitting part) growth arises in a light emitting device.

[0016] Moreover, if an organic layer is formed thickly and all local upheaval on an anode plate 12 tends to be covered, since the luminescence starting potential of an organic light emitting device will rise, the problem said that a light emitting device property falls arises.

[0017] This invention aims at proposing the organic light emitting device which solved problems generated by local upheaval of the conductive film of an anode plate, such as short-circuit and a dark spot, in view of the above-mentioned actual condition.

[0018]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, it is related with the organic light emitting device which consists of cathode which carried out membrane formation on the organic layer which the transparence substrate side was made to deposit the anode plate of the transparence which carried out membrane formation, and on this anode plate film, and this organic layer.

[0019] And it has been the description that the organic light emitting device of this invention equipped the transparence substrate side with the anode plate of the two-layer configuration which carried out film formation of the transparent conductive film amorphous on it for the transparent conductive film of polycrystal respectively.

[0020]

[Function] Thus, the anode plate of the constituted organic light emitting device is covered with the transparent conductive film with the amorphous local upheaval generated on the transparent conductive film of polycrystal. Moreover, granular growth does not arise and the amorphous transparent conductive

film serves as a uniform and flat film surface.

[0021] Consequently, since the organic layer deposited on the anode plate film is formed on the amorphous transparent conductive film, an organic layer is not broken through by the granular local upheaval produced on the anode plate film. It becomes an organic light emitting device without the short-circuit resulting from local upheaval of the anode plate film, or a dark spot from this.

[0022]

[Embodiment of the Invention] Next, 1 operation gestalt of this invention is explained along with a drawing. Drawing 1 is the simple block diagram showing the organic light emitting device of this operation gestalt. As for this organic light emitting device, everything but an anode plate configuration has an organic light emitting device of the conventional example shown in drawing 3, and this composition so that it may illustrate.

[0023] And as shown in drawing 2, membrane formation formation of the transparent conductive film 12a of polycrystal is carried out as the 1st layer of an anode plate on the field of the transparent glass substrate (or transparent plastic plate) 11, membrane formation formation of the still more nearly amorphous transparent conductive film 12b as the 2nd layer of an anode plate is carried out, and the transparent conductive film 12a and 12b of these two-layer configuration constitutes the anode plate 12 from this operation gestalt.

[0024] Moreover, transparent conductive film 12a of polycrystal carries out thin film formation at 1000Å using ITO material, and using IXO (trade name of Idemitsu Kosan, Inc.), 500Å - 1000Å amorphous transparent conductive film 12b is deposited, and has carried out film formation. IXO is In<sub>2</sub>O<sub>3</sub>-ZnO system amorphous transparence electric conduction material.

[0025] In addition, patterning of these transparent conductive film 12a and 12b is carried out to an electrode configuration after membrane formation according to vacuum membrane formation or wet process.

[0026] Since the local upheaval which generates the anode plate 12 formed as mentioned above in transparent conductive film 12a in a film formation process is covered with transparent conductive film 12b, it serves as a uniform flat film surface according [ the front face of an anode plate 12 ] to transparent conductive film 12b.

[0027] Therefore, since the electron hole transportation layer 13 can be made to deposit on the flat film surface of amorphous transparent conductive film 12b, it breaks through in the electron hole transportation layer 13, and a part does not arise.

[0028] Thus, since it had the anode plate 12 constituted using the advantage of transparent conductive film 12a of the small polycrystal of specific resistance, and amorphous transparent conductive film 12b which does not produce local upheaval although specific resistance is larger than this transparent conductive film 12a, it becomes an organic light emitting device without the short-circuit and generating of a dark spot resulting from local upheaval of an anode plate 12.

[0029] As mentioned above, although 1 operation gestalt of this invention was explained, transparent conductive film 12a can be formed by the other ZnO(s) material of ITO material, SnO<sub>2</sub> material, etc., and transparent conductive film 12b can be formed not only by IXO but by the same amorphous material.

[0030] Furthermore, the anode plate 12 of the above-mentioned operation gestalt can be similarly carried out about the organic light emitting device shown in drawing 4, drawing 5, and drawing 6 as a conventional example.

[0031]

[Effect of the Invention] Since the organic light emitting device of this invention was equipped with the anode plate considered as the two-layer film configuration by the transparent conductive film of polycrystal, and the amorphous transparent conductive film, it turns into a good organic light emitting device without short-circuit or a dark spot, as described above.

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**TECHNICAL FIELD**

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## PRIOR ART

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**EFFECT OF THE INVENTION**

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**TECHNICAL PROBLEM**

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**MEANS**

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## OPERATION

[Function] Thus, the anode plate of the constituted organic light emitting device is covered with the transparent conductive film with the amorphous local upheaval generated on the transparent conductive film of polycrystal. Moreover, granular growth does not arise and the amorphous transparent conductive film serves as a uniform and flat film surface.

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of a dark spot resulting from local upheaval of an anode plate 12.

[0029] As mentioned above, although 1 operation gestalt of this invention was explained, transparent conductive film 12a can be formed by the other ZnO(s) material of ITO material, SnO<sub>2</sub> material, etc., and transparent conductive film 12b can be formed not only by IXO but by the same amorphous material.

[0030] Furthermore, the anode plate 12 of the above-mentioned operation gestalt can be similarly carried out about the organic light emitting device shown in drawing 4 , drawing 5 , and drawing 6 as a conventional example.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] It is the simple block diagram of an organic light emitting device showing 1 operation gestalt of this invention.

[Drawing 2] It is the simplified schematic showing the anode plate configuration with which the above-mentioned organic light emitting device was equipped.

[Drawing 3] It is the simple block diagram of the organic light emitting device shown as a conventional example.

[Drawing 4] It is the simple block diagram of the same organic light emitting device as drawing 3 which is not equipped with an electronic transportation layer.

[Drawing 5] It is the simple block diagram of the same organic light emitting device as drawing 3 which is not equipped with an electron hole transportation layer.

[Drawing 6] It is the simple block diagram of the same organic light emitting device as drawing 3 which is not equipped with an electron hole transportation layer and an electronic transportation layer.

[Drawing 7] It is the simplified schematic having shown the anode plate configuration of the organic light emitting device shown as a conventional example.

**[Description of Notations]**

11 Glass Substrate

12 Anode Plate

12a Transparent conductive film of polycrystal

12b Amorphous transparent conductive film

13 Electron Hole Transportation Layer

14 Luminous Layer

15 Electronic Transportation Layer

16 Cathode

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[Translation done.]

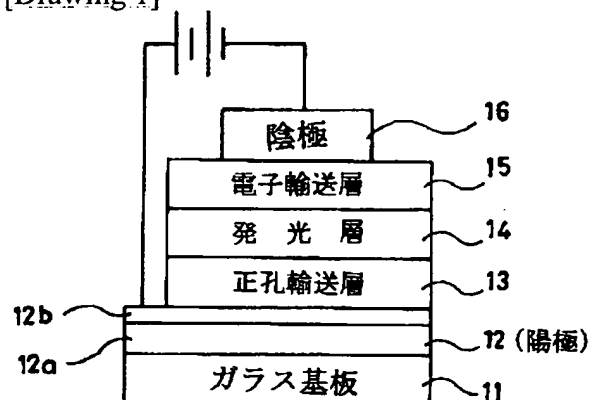
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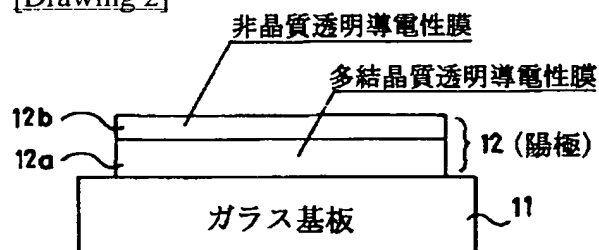
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## DRAWINGS

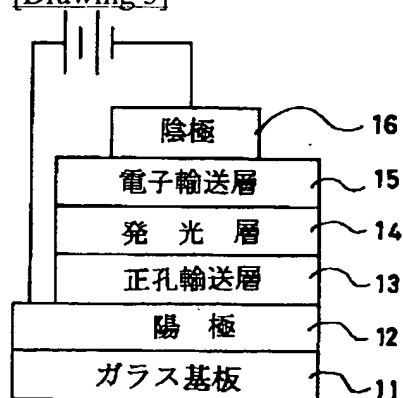
[Drawing 1]



[Drawing 2]

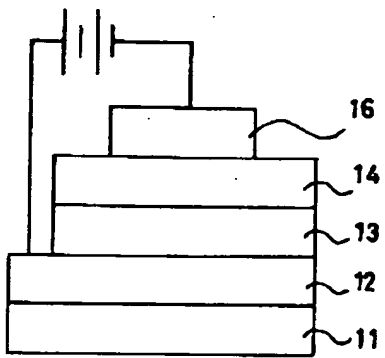


[Drawing 3]

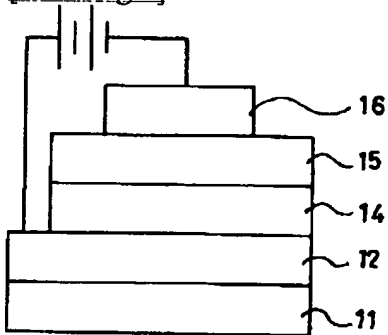


[Drawing 4]

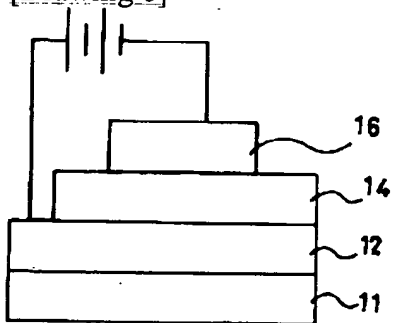




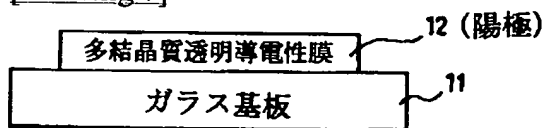
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]

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(P2002-100483A)

(43)公開日 平成14年4月5日(2002.4.5)

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H 0 5 B 33/28		H 0 5 B 33/28	3 K 0 0 7
33/14		33/14	A

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(22)出願日	平成12年9月22日(2000.9.22)

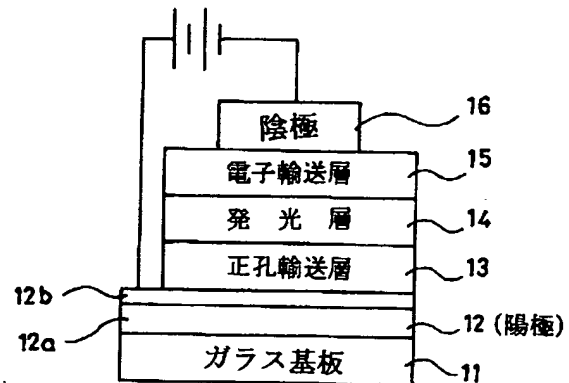
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(74)代理人 100076196  
弁理士 小池 寛治  
Fターム(参考) 3K007 AB00 AB05 CA01 CA05 CB01  
CB04 DA00 DB03 EB00 FA01

(54)【発明の名称】 有機発光素子

(57)【要約】

【課題】 陽極の透明導電性膜の局部隆起によって起因するショートやダークスポットなどの問題を解決した有機発光素子を提供すること。

【解決手段】 ガラス基板11の面上に、多結晶質の透明導電性膜12aを、その上に非晶質の透明導電性膜12bを各々膜形成した2層構成の陽極12を備えた有機発光素子となっている。



【特許請求の範囲】

【請求項1】 透明基板面に成膜形成した透明の陽極と、この陽極膜の上に堆積させた有機層と、この有機層の上に成膜形成した陰極とからなる有機発光素子において、

透明基板面に多結晶質の透明導電性膜を、その上に非晶質の透明導電性膜を各々膜形成した2層構成の陽極を備えたことを特徴とする有機発光素子。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、有機材からなる発光層を備えた有機発光素子に関する。

【0002】

【従来の技術】図3は有機発光素子の一例を示す簡略構成図である。図示するように、この有機発光素子は、陽極12を膜形成した透明なガラス基板11の上に、正孔輸送層13、発光層14、電子輸送層15を順次膜形成し、さらに、電子輸送層15に陰極16を膜形成した構造となっている。なお、ガラス基板11は、透明なプラスチック材で形成されたものがある。

【0003】陽極12は、仕事関数の大きい金属や合金によって形成されている。具体的には、ITO（インジウムスズの酸化物）、 $\text{SnO}_2$ （酸化スズ）、 $\text{ZnO}$ （酸化亜鉛）などを使って形成した多結晶質の透明導電性膜となっている。

【0004】また、正孔輸送層13、発光層14、電子輸送層15は有機材（有機化合物）によって膜形成されている。具体的には、 $\text{Alq}_3$ （アルミキレート錯体）、TPD（芳香族ジアミン）によって代表される低分子系材やPPV（ポリフェニレンビニレン）誘導体によって代表される高分子系材が使用されている。

【0005】上記陰極16は、仕事関係の小さい金属や合金、または、これら金属や合金の混合物によって形成されている。具体的には、Ca（カルシウム）、Al（アルミニウム）、Al-Li（リチウム）合金、Mg（マグネシウム）-Ag（銀）合金、Mg-Al合金、Mg-In（インジウム）合金などを蒸着やスパッタリングなどの方法によって薄膜形成した陰極となっている。

【0006】上記した有機発光素子は、陽極12と陰極16とに直流電圧を印加することにより、陽極12より注入される正孔が正孔輸送層13を経て発光層14に送られる。また、陰極16より注入される電子が電子輸送層15を経て発光層14に送られる。発光層14では正孔と電子とが再結合し、これによって発光層14の有機材が励起状態となり励起子が生成する。

【0007】このように生成した励起子は発光層14内を拡散し、続いてその基底状態へと脱励起され、その時に発光し、この発光が正孔輸送層13、陽極12、ガラス基板11を通して射出される。

【0008】図4は、発光層14が電子輸送層15を兼ねるように構成された有機発光素子の簡略構成図である。この発光素子は、ガラス基板11に陽極12を膜形成し、その上に、正孔輸送層13と発光層14が積層されており、陰極16が発光層14に膜形成されている。

【0009】図5は、発光層14が正孔輸送層13を兼ねる有機発光素子の簡略構成図である。この発光素子は、ガラス基板11に陽極12を膜形成し、その上に発光層14と電子輸送層15とが積層されており、陰極16が電子輸送層15に膜形成されている。

【0010】図6は、正孔輸送層13と電子輸送層15を備えない有機発光素子の簡略構成図である。この発光素子は、ガラス基板11に陽極12を膜形成し、その上に発光層14が積層されており、陰極16が発光層14に膜形成されている。

【0011】図4、図5、図6に示す有機発光素子は、図3に示した有機発光素子と同様に陽極12と陰極16とに直流電圧を印加することにより発光し、この発光が陽極12とガラス基板11を通して射出する。

【0012】上記した従来の有機発光素子の発光色は、発光層14の有機材に依存するところが大きい。現在では、緑色、黄色、橙色、赤色、青色の発光色の有機発光素子が実用化され、また、提案されている。

【0013】

【発明が解決しようとする課題】上記した有機発光素子の陽極12は、図7に示すようにガラス基板11の面上に多結晶質の透明導電性膜を真空成膜またはウェットプロセスによって成膜後、電極形状にパターニングして薄膜形成されている。

【0014】したがって、陽極12を多結晶質のITOを用いて成膜形成する場合、膜形成過程で結晶粒（グレイン）の部分的成長が生じ、膜面上に結晶の局部隆起（不規則配置の多数の突状部）が生じる。

【0015】この局部隆起は大きさ（高さ）が1500Å以上にもなるため、陽極12上に堆積させる有機層（正孔輸送層或いは発光層）を突き破るようになる。このため、発光素子にショートやダークスポット（非発光部）成長に起因した欠陥が生じる。

【0016】また、有機層を厚く形成し、陽極12上の局部隆起を被い尽くそうとすると、有機発光素子の発光開始電圧が上昇するため、発光素子特性が低下すると言う問題が生じる。

【0017】本発明は上記した実情にかんがみ、陽極の導電性膜の局部隆起によって発生するショートやダークスポットなどの問題を解決した有機発光素子を提案することを目的とする。

【0018】

【課題を解決するための手段】上記した目的を達成するため、本発明では、透明基板面に成膜形成した透明の陽極と、この陽極膜の上に堆積させた有機層と、この有機

層の上に成膜形成した陰極とからなる有機発光素子に関する。

【0019】そして、この発明の有機発光素子は、透明基板面に多結晶質の透明導電性膜を、その上に非晶質の透明導電性膜を各々膜形成した2層構成の陽極を備えたことが特徴となっている。

【0020】

【作用】このように構成した有機発光素子の陽極は、多結晶質の透明導電性膜に発生した局部隆起が非晶質の透明導電性膜によって被われる。また、非晶質の透明導電性膜は粒状成長が生じなく均一で平坦な膜面となる。

【0021】この結果、陽極膜の上に堆積する有機層が非晶質の透明導電性膜上に成膜されることから、有機層が陽極膜に生ずる粒状の局部隆起によって突き破られることがない。このことから、陽極膜の局部隆起に起因するショートやダークスポットのない有機発光素子となる。

【0022】

【発明の実施の形態】次に、本発明の一実施形態について図面に沿って説明する。図1は、本実施形態の有機発光素子を示す簡略構成図である。図示するように、この有機発光素子は陽極構成の他は図3に示す従来例の有機発光素子と同構成となっている。

【0023】そして、本実施形態では、図2に示した如く、透明なガラス基板（または、透明なプラスチック基板）11の面上に陽極第1層として多結晶質の透明導電性膜12aを成膜形成し、さらに、陽極第2層として非晶質の透明導電性膜12bを成膜形成し、これら2層構成の透明導電性膜12a、12bによって陽極12が構成してある。

【0024】また、多結晶質の透明導電性膜12aはITO材を使用して1000Åに薄膜形成し、また、非晶質の透明導電性膜12bはIXO（出光興産株式会社の商品名）を使用して500Å～1000Å堆積して膜形成してある。IXOは $\text{In}_2\text{O}_3$ -ZnO系アモルファス透明導電材である。

【0025】なお、これら透明導電性膜12a、12bは真空成膜またはウェットプロセスによって成膜後、電極形状にパターニングする。

【0026】上記のように形成した陽極12は、膜形成工程において透明導電性膜12aに発生する局部隆起が透明導電性膜12bによって被われるため、陽極12の表面が透明導電性膜12bによる均一な平坦膜面となる。

【0027】したがって、正孔輸送層13を非晶質の透

明導電性膜12bの平坦膜面に堆積させることができることから、正孔輸送層13に突き破り部所が生じない。

【0028】このように、比抵抗の小さい多結晶質の透明導電性膜12aと、この透明導電性膜12aより比抵抗が大きいが局部隆起を生じない非晶質の透明導電性膜12bとの長所を利用して構成した陽極12を備えたことから、陽極12の局部隆起に起因するショートやダークスポットの発生のない有機発光素子となる。

【0029】以上、本発明の一実施形態について説明したが、透明導電性膜12aはITO材の他ZnO材、 $\text{SnO}_2$ 材などで形成することができ、また、透明導電性膜12bはIXOにかぎらず同様の非晶質材で形成することができる。

【0030】さらに、上記した実施形態の陽極12は、図4、図5、図6に従来例として示した有機発光素子についても同様に実施することができる。

【0031】

【発明の効果】上記した通り、本発明の有機発光素子は、多結晶質の透明導電性膜と非晶質の透明導電性膜とで2層膜構成とした陽極を備えたことから、ショートやダークスポットのない良質な有機発光素子となる。

【図面の簡単な説明】

【図1】本発明の一実施形態を示す有機発光素子の簡略構成図である。

【図2】上記有機発光素子に備えた陽極構成を示す簡略図である。

【図3】従来例として示した有機発光素子の簡略構成図である。

【図4】電子輸送層を備えない図3同様の有機発光素子の簡略構成図である。

【図5】正孔輸送層を備えない図3同様の有機発光素子の簡略構成図である。

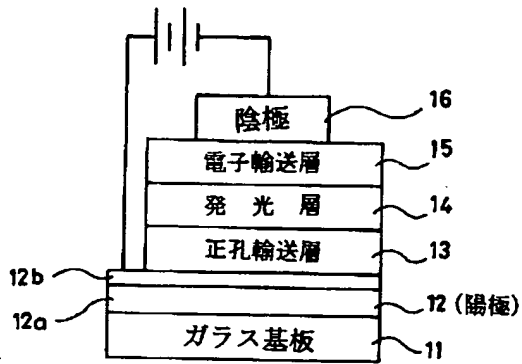
【図6】正孔輸送層と電子輸送層とを備えない図3同様の有機発光素子の簡略構成図である。

【図7】従来例として示した有機発光素子の陽極構成を示した簡略図である。

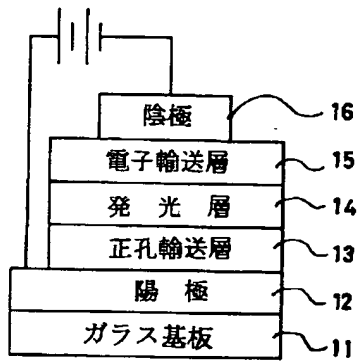
【符号の説明】

- 11 ガラス基板
- 12 陽極
- 12a 多結晶質の透明導電性膜
- 12b 非晶質の透明導電性膜
- 13 正孔輸送層
- 14 発光層
- 15 電子輸送層
- 16 陰極

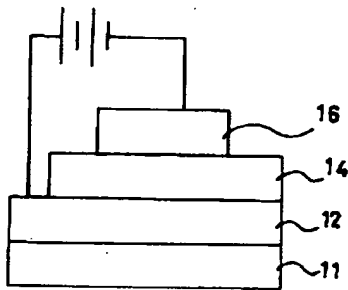
【図1】



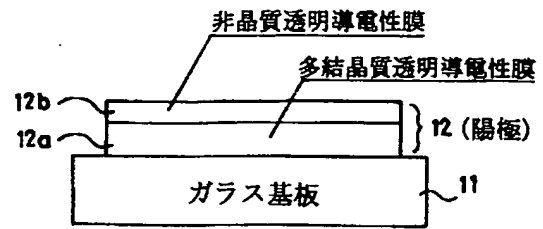
【図3】



【図6】

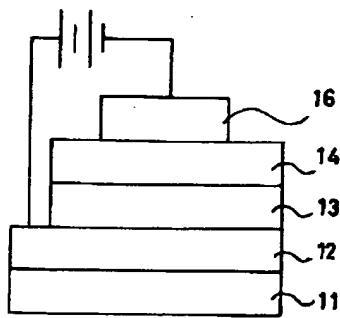


【図2】



【図5】

【図4】



【図7】

